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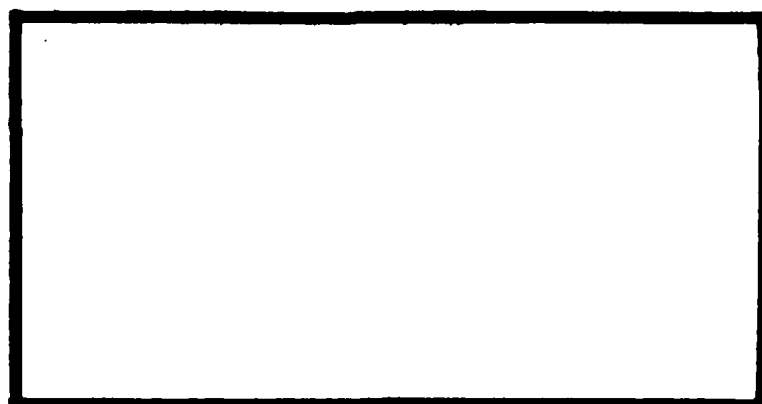


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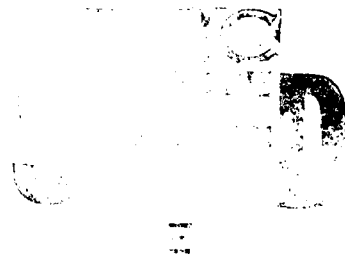
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FACTOR IDENTIFICATION AND FACTOR SCORE
ESTIMATION IN ORGANIZATIONAL ENVIRONMENTS

William H. Hendrix, Lt Col, USAF

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A series of factor analyses were performed to extract organizational factors from data collected (N=4786) on Air Force personnel using the Organizational Assessment Package (OAP). The 22 factors extracted were orthogonally rotated and then each rotated factor had its internal consistency computed using the Cronbach Alpha technique. In order to reduce the number of items within the OAP, a factor score estimation methodology was developed. This included computing factor coefficients for use in deriving factor scores. Then a sub-set of items for each factor was regressed against factor scores as a means of factor score estimation. Factors, factor score coefficients, and factor score estimation results are presented.

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A School of Systems and Logistics AU-AFIT-LS Technical Report

Air University

Air Force Institute of Technology

Wright-Patterson AFB, Ohio

By

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FACTOR IDENTIFICATION AND FACTOR SCORE ESTIMATION
IN ORGANIZATIONAL ENVIRONMENTS

Introduction

Within organizations, management is concerned with how well their organization meets their objectives. These objectives are frequently measured in terms of productivity, cost savings, and retention of personnel. The Air Force continues to be vitally concerned with this area of organizational effectiveness. This interest includes organizational behavior research, implementation of organizational effectiveness programs such as job enrichment, and evaluation of organizational development programs Air Force wide.

Problem

The Organizational Assessment Package (OAP) (Hendrix & Halverson, 1979) was developed by the Air Force Human Resources Laboratory for use by the Air Forces' Leadership and Management Development Center in assessing organizational effectiveness. The OAP was developed within a contingency model of management framework. The model assumed organizational effectiveness to be a function of the manager, the situational environment, and criteria of success. The OAP was composed of a Background Information section and five attitudinal sections which were entitled: Job Satisfaction Questionnaire, Organizational Climate Inventory, Perceived Productivity Inventory, Job Inventory, and Supervisor Inventory. This paper reports results of a series of factor analyses performed on data collected using the Organizational

This research was presented at the Eighty-seventh Annual Convention of the American Psychological Association, New York, New York, 1-5 September 1979.

Assessment Package (OAP). The problem was to identify those organizational factors measured by the OAP, and develop a method for efficiently measuring individual factor scores.

Subjects

The subjects were 4786 military and civilian personnel at 5 Air Force bases representing 6 major commands. Of these, approximately 86% were male, 14% female, 17% officers, 65% enlisted, and 18% civilians.

Procedure

The Organizational Assessment Package (OAP) was administered to Air Force personnel by consultants from the Air Force's Leadership and Management Development Center. Respondents completed the OAP by providing their responses on an optical scan answer form. The optical scan answer sheets were shipped to the Air Force Human Resources Laboratory for data analysis.

Data Analysis

Data collected using the Organizational Assessment Package (OAP) was subjected to a series of orthogonally rotated factor analyses. Five separate factor analyses were performed; one on each of the 5 attitudinal sections in the OAP. In addition, factor score coefficients for each factor were computed. This provided a means of computing a factor score for each individual on a given factor. The next analysis involved establishing the internal consistency of each factor using the Cronbach Alpha (Cronbach, 1951) technique. The highest loading two items had their Cronbach Alpha index computed first, and iteratively the next highest loading item was added until all items logically loading together were computed. The final analysis involved developing prediction equations to predict factor scores from a small sub-set of items for each factor.

Results

The five separate factor analyses resulted in twenty-two factors being extracted. Table 1 lists the factors extracted, the percent total variance

extracted. Table 1 lists the factors extracted, the percent total variance accounted for by each factor, each factor's highest loading, and the number of loadings above .50.

*Table 1 OAP Section Factor Analyses
(Rotated Factors)*

Section/Factor	Percent Total Variance	Highest Loading	Loadings Above .50
Job Inventory			
Job Enrichment	12.24	.73	9
Freedom-Autonomy	6.34	.79	3
Time Management	6.82	.80	4
Supervisor Influence	7.33	.77	4
Advancement	4.95	.80	3
Work Group Performance	5.90	.74	3
Equipment - Work Space	3.90	.74	2
Work Repetition	4.11	.81	2
Task Accomplishment	4.06	.64	3
Total	55.70		
Organizational Climate Inventory			
General Climate	33.56	.76	17
Communications/Planning	24.62	.86	8
Total	58.18		
Supervisory Inventory			
Management-Supervision	30.56	.77	27
Supervisor Assistance/Feedback	26.51	.76	20
Autonomous Control	5.59	.69	4
Total	62.63		
Need for Enrichment (NEI)			
Meaningful-Responsible Work	49.17	.87	8
Repetitive-Easy Job	15.92	.85	2
Total	65.09		
Perceived Productivity			
High Productivity	43.82	.83	5
Performance Disruption	17.51	.78	2
Total	61.32		
Job Satisfaction			
General Satisfaction	36.50	.77	16
Base Facilities	8.70	.79	3
Training	5.37	.53	2
Local Area Social	5.17	.67	2
Total	55.74		

The Coefficient Alpha indices computed for items on each factor served as a cutting point for establishing the sub-set of reliable items in each factor to use in predicting the factor scores obtained by using all items loading on a given factor. Table 2 lists the factor loadings for OAP variables and the Coefficient Alpha indices. The data indicate a small sub-set (e.g., 3-10) could be reliably used to measure the larger set of factor items (e.g., 30). The results associated with the development of regression equations for predicting factor scores from a small number of variables is provided in Table 3. The R^2 values associated with each factor indicates that most of the predictive variance can be accounted for by the factor estimate equations which contain significantly fewer variables than used to compute the original factor scores.

Conclusion

The Organizational Assessment Package (OAP) provides the Air Force with an attitudinal survey which measures 22 orthogonal organizational factors. Not all items in the OAP were required in order to reliably compute individual factor scores. They could be reliably estimated from a smaller sub-set. The OAP, therefore, can be reduced in length by deletion of those items not required

Table 2 OAP Sections Detailed Factor Analyses

Var.	Loading	Alpha	Var.	Loading	Alpha	Var.	Loading	Alpha	Var.	Loading	Alpha
Situational Environment											
Job Enrichment			Task Autonomy			Planning and Time Management			Supervisor Influence ^a		
213	.73		213	.79		224	.80		247	.77	
244	.70	.86d	214	.78	.81d	223	.68	.71d	246	.74	.79
210	.63	.79d	214	.67	.83d	225	.61	.71d	245	.74	.84
203	.61	.81d	248	.49	.84d	222	.59	.70d	248	.60	.86
201	.58	.82d	205	.41	.84	219	.45	.70d	216	.44	.84
212	.54	.84d	209	.36	.86	229	.39	.71d	241	.38	.85
230	.52	.85d	211	.35	.86	232	.36	.73d	217	.31	.85
209	.51	.86d	246	.28		231	.35	.76d	244	.31	.86
217	.49	.87d	231	.28		235	.35	.78d	220	.27	
202	.49	.87d	202	.25		241	.25		236	.26	
Advancement/Recognition			Equipment/Work Space/Goal Clarity ^b			Work Repetition			Task Accomplishment ^c		
239	.80		208	.74		226	.81		218	.64	
240	.64	.69d	207	.65	.53d	227	.80	.71d	206	.52	.32d
234	.61	.69d	220	.34	.56	228	.47	.62	228	.51	.40d
241	.48	.75d	211	.31	.62	225	.23		212	.42	.46d
233	.27		209	.30	.70	244	.22		201	.41	.58d
231	.21		217	.30	.75	215	.17		202	.32	.62d
235	.21		221	.28		223	.17		230	.31	.68d
244	.20		213	.26		206	.17		220	.27	
219	.19		202	.22		202	.16		221	.27	
221	.19		234	.21		203	.15		217	.22	
Supervisory Inventory											
Management/Supervision			Supervisor Assistance/Feedback			Autonomous/ Autonomously Controls ^c					
404	.77		435	.76		421	.69				
412	.76	.86d	437	.74	.85d	419	.65	.53d			
413	.73	.89d	442	.73	.87d	415	.56	.51d			
416	.72	.90d	433	.71	.91d	417	.56	.58d			
411	.72	.91d	431	.71	.92	434	.35	.55			
414	.71	.93d	436	.69	.92	425	.31	.60			
405	.70	.93d	429	.68	.93	422	.29	.66			
410	.68	.94d	438	.67	.94	443	.29				
440	.68	.95	428	.66	.95	403	.28				
406	.67	.95	427	.62	.95	426	.26				
Organization Climate Inventory											
General Organizational Climate			Organizational Communications Climate			High Productivity			Performance Distribution		
111	.76		104	.86		260	.83		262	.78	
121	.75	.82d	103	.84	.88d	265	.80	.74d	263	.77	.34
110	.73	.85d	105	.71	.86d	261	.78	.80d	259	.16	
122	.71	.87d	107	.67	.87d	259	.72	.81d	264	.05	
109*	.69	.90d	113	.61	.89d	264	.71	.82d	260	.05	
112	.69	.90d	124	.59	.89	263	.24		261	.01	
116	.66	.91d	106	.52	.90	262	.23		265	.01	
115	.66	.92d	102	.51	.91						
117	.66	.92d	120	.48	.91						
114	.61	.91d	109	.44	.92						
			114	.44	.93						

Table 2 (Continued)

Var.	Loading	Alpha	Var.	Loading	Alpha	Var.	Loading	Alpha	Var.	Loading	Alpha
Job Satisfaction											
Job Related Satisfaction			Local Area/Social Satisfaction ^b			Training			Base Facilities		
717	.75		707	.81		711	.80		721	.86	
723	.72	.62 ^d	708	.69	.63 ^d	712	.79	.71 ^d	720	.78	.75 ^d
716	.69	.78 ^d	706	.45	.64	704	.45	.67	722	.71	.74 ^d
718	.68	.79 ^d	705	.39	.72	713	.43	.73	707	.20	
719	.63	.82 ^d	709	.36	.75	705	.39	.77	715	.18	
710	.56	.84 ^d	714	.35	.77	709	.38	.80	704	.17	
715	.52	.85 ^d	704	.33	.80	706	.35	.82	714	.16	
705	.50	.86 ^d	713	.28		716	.31	.84	718	.14	
713	.50	.87 ^d	716	.28		719	.31	.86	717	.14	
714	.42	.88 ^d	710	.27		723	.29		711	.12	
Need for Enrichment											
Meaningful/ Responsible Work			Desired Repetitive/ Easy Tasks								
252	.87		255	.86							
253	.84	.85 ^d	258	.83	.64						
251	.84	.88 ^d	254	.22							
250	.83	.91 ^d	251	.19							
254	.82	.92 ^d	250	.18							
249	.69	.92	256	.14							
256	.68	.92	252	.13							
257	.66	.91	253	.09							
255	.10		249	.04							
258	.05		257	.04							

^aThis factor recommended for deletion since in the overall OAP factor analysis variables listed here load on factor in the Supervisor Inventory.

^bRecommend deletion since internal consistency index is low for variables recommended for inclusion. Additional variables not recommended for inclusion since they do not logically relate to the factor.

^cThis factor is weak in terms of internally consistency. Should this factor be included, additional items to strengthen it is recommended.

^dRecommended for inclusion.

NOTE: OAP variable numbers listed identify specific OAP items. These numbers can be found in Hendrix and Halverson (1979).

Table 3
Estimated Factor Score Regression Variables

Analysis Number	Factor	Estimated Factor Score Variables ^a	
		R ²	Dependent Variable
1	General Organizational Climate	.827	830
			111, 121, 110, 122, 109, 112, 116, 115, 117, 114.
2	Organizational Communications Climate	.838	831
			104, 103, 105, 107, 113
3	Job Related Satisfaction	.849	832
			717, 723, 716, 718, 719, 710, 715, 705, 713, 714.
4	Perceived Productivity	.989	833
			260, 265, 261, 259, 264.
5	Job Enrichment	.743	840
			215, 244, 210, 203, 201, 212, 230, 209, 217, 202.
6	Planning/Time Management	.883	841
			224, 223, 225, 222, 219, 229, 232, 231, 235.
7	Task Autonomy	.778	842
			213, 204, 214, 248.
8	Advancement/Recognition	.764	843
			239, 240, 234, 241.
9	Task Accomplishment	.766	844
			218, 206, 228, 212, 201, 202, 230.
10	Work Repetition	.835	845
			226, 227.
11	Meaningful/Response	.920	846
			252, 253, 251, 250, 254.
12	Management/Supervision	.732	847
			404, 412, 413, 416, 411, 414, 405, 410.
13	Supervisor Assistance/Feedback	.673	848
			435, 437, 442, 433.
14	Autonomous Control	.847	849
			421, 419, 415, 417.
15	Training Satisfaction	.858	850
			711, 712.
16	Base Facilities Satisfaction	.944	851
			721, 720, 722.

^aOAP variable numbers listed identify specific OAP items. These numbers can be found in Hendrix and Halverson (1979).

in the prediction sub-set. These factor scores when computed on work groups in organizations provide reliable indices which can be used in a pre-test/post-test design with control groups to establish organizational effectiveness due to differential change strategies.

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